

Claims

- [c1] A method to locally remove polymer sealant from a semiconductor device comprising:
- providing at least a first component having a thermoset polymer sealant on a surface thereof;
 - detecting said thermoset polymer sealant on said portion of said surface;
 - applying a depolymerization cleaning solution to said detected thermoset polymer sealant, said depolymerization cleaning solution comprising a salt saturated solvent having surfactant;
 - contacting said thermoset polymer sealant with said depolymerization cleaning solution such that said solution chemically degrades said thermoset polymer sealant for the removal thereof; and
 - removing said degraded thermoset polymer sealant from said surface of said at least first component.
- [c2] The method of claim 1 wherein said at least first component comprises a structure selected from the group consisting of a substrate, a base plate, a metal cap, a ceramic chip carrier, an organic chip carrier and a heat sink.

- [c3] The method of claim 1 wherein said thermoset polymer sealant is within a sealband area on said first component surface.
- [c4] The method of claim 3 wherein said thermoset polymer sealant is within said sealband area on said first component surface, the method further including:
providing a confinement means on said surface of said at least first component to isolate said sealband area from any electrically active features on said surface, therein said confinement means protecting and avoiding contact of said electrically active features with said applied depolymerization cleaning solution.
- [c5] The method of claim 1 wherein said steps of detecting said thermoset polymer sealant and applying said depolymerization cleaning solution comprises:
detecting said thermoset polymer sealant on said portion of said surface, said detected thermoset polymer sealant comprising bulk thermoset polymer sealant;
removing a substantial portion of said bulk thermoset polymer sealant such that residual thermoset polymer sealant remains on said portion of said surface;
heating said at least first component having said residual thermoset polymer sealant to a temperature under the boiling point of the solvent said solution; and

locally applying said depolymerization cleaning solution substantially only to said residual thermoset polymer sealant in an amount sufficient to at least cover said residual thermoset polymer sealant.

[c6] The method of claim 5 wherein said temperature ranges from about 25°C to about 70°C.

[c7] The method of claim 5 further including the steps:
allowing said depolymerization cleaning solution to remain on said surface for a sufficient time to allow said depolymerization cleaning solution to depolymerize said residual thermoset polymer sealant;
rinsing at least said depolymerized residual thermoset polymer sealant off said surface of said at least first component; and
drying said rinsed at least first component to provide a clean sealing surface of said at least first component for a subsequent rework process.

[c8] The method of claim 7 wherein said sufficient time ranges from about 5 minutes to about 25 minutes.

[c9] The method of claim 7 wherein said step of drying said rinsed first component comprises:
pre-drying said rinsed at least first component; and
completely drying said pre-dried at least first component

to remove any remaining moisture on said surface of said at least first component.

- [c10] The method of claim 1 wherein said thermoset polymer sealant comprises a silicone-based adhesive.
- [c11] The method of claim 1 wherein said depolymerization cleaning solution comprises a metal hydroxide or amino onium soluble salt in a solvent having surfactant, where all constituents form a blend in solution.
- [c12] The method of claim 11 wherein said depolymerization cleaning solution comprises:
said soluble salt selected from the group consisting of KOH, alkali acetate ($\text{CH}_3\text{CO}_2\text{Na}$, $\text{CH}_3\text{CO}_2\text{K}$), alkali propionate ($\text{CH}_2\text{H}_5\text{CO}_2\text{Na}$), alkali amide (NaNH_2), sodium acrylate ($\text{H}_2\text{C}=\text{CHCO}_2\text{Na}$), NaF, KF, LiF, $\text{Na}_2\text{Si}_3\text{O}_7$, sodium hydrosulfite ($\text{Na}_2\text{S}_2\text{O}_4$), monoesters and/or diesters of phosphoric acid of the general formula: $\text{O}=\text{P}(\text{OH})_n(\text{OR})_{3-n}$, n is 1, 2 or 3, Na_2HPO_4 , NaSO_3R ($\text{R}=\text{C}_1-\text{C}_6$ -alkyl or phenyl), Na_2HPO_4 , K_2HPO_4 , TBAF, TEAH, TBAH, TMAH, TMAF, TPAF, TEAB, TBAI, tetrabutylammonium tetrafluoroborate (TBA-TFB), NH_2NH_2 , NH_2OH , $\text{N}(\text{CH}_2\text{CH}_3)_3$ and combinations thereof;
said solvent selected from the group consisting of water, methanol, ethanol, propanol, isopropanol, tert-butyl alcohol, dimethyl sulfoxide (DMSO), acetonitrile, dimethyl-

formamide (DMF), nitromethane, hexamethyl phosphoramide (HMPA), acetone, cyclohexanone, pyridine and combinations thereof; and

said surfactant selected from the group consisting of fluorosurfactant (1, 4-dioxane), nonionic surfactant (alcohol ethoxylate), poly (ethylene glycol monooleate), an organic surfactant and combinations thereof.

[c13] The method of claim 12 wherein said soluble salts are further selected from the group consisting of aliphatic hydrocarbons, naphthenic hydrocarbons, aromatic hydrocarbons and combinations thereof.

[c14] The method of claim 11 wherein said metal hydroxide or amino onium salt is present in an amount ranging from about 1.0 wt% to about 50.0 wt% of said cleaning solution for generating nucleophiles via dissociation in said solvent, and said surfactant is present in an amount ranging from about 0.1 wt% to about 5.0 wt% of said cleaning solution for accelerating surface wetting and preventing corrosion.

[c15] A method for reworking an electronic module comprising:
providing an electronic module having a first component attached to a second component via a sealband area of thermoset polymer sealant;

detaching said first and second components from each other such that portions of said thermoset polymer sealant remain on at least one of said first and second components;

locally applying a depolymerization cleaning solution to said sealband area having remaining thermoset polymer sealant, said depolymerization cleaning solution comprising a salt saturated solvent having surfactant;

contacting said remaining thermoset polymer sealant with said depolymerization cleaning solution such that said solution chemically degrades said thermoset polymer sealant within said sealband area for the removal thereof; and

removing said degraded thermoset polymer sealant from said surface of said at least one of said first and second components to provide a clean sealing surface of said at least one of said first and second components for a subsequent rework process.

[c16] The method of claim 15 wherein said remaining portions of said polymer sealant comprises bulk polymer sealant, and the method further including removing substantially all of said bulk polymer sealant therein leaving residual polymer sealant within said sealband area on said surface.

- [c17] The method of claim 15 further including the step of providing a confinement means on said surface of at least one of said first and second components to isolate said sealband area from any electrically active features on said surface, therein said confinement means protecting and avoiding contact of said electrically active features with said applied depolymerization cleaning solution.
- [c18] The method of claim 15 further including the step of heating said at least one of said first and second components to a temperature under the boiling point of the solvent said solution prior to locally applying said depolymerization cleaning solution to said remaining thermoset polymer sealant within said sealband area.
- [c19] The method of claim 15 further including the step of drying said clean sealing surface of said at least one of said first and second components for said subsequent rework process.
- [c20] A depolymerizing cleaning composition comprising a premixed salt saturated solvent having a surfactant for chemical degradation of thermoset polymer systems, said salt being selected from the group consisting of a metal hydroxide salt and an amino onium salt, wherein all constituents form a blend in solution.

[c21] The composition of claim 20 wherein said salt is further selected from the group consisting of KOH, alkali acetate ($\text{CH}_3\text{CO}_2\text{Na}$, $\text{CH}_3\text{CO}_2\text{K}$), alkali propionate ($\text{CH}_2\text{H}_5\text{CO}_2\text{Na}$), alkali amide (NaNH_2), sodium acrylate ($\text{H}_2\text{C}=\text{CHCO}_2\text{Na}$), NaF, KF, LiF, $\text{Na}_2\text{Si}_3\text{O}_7$, sodium hydrosulfite ($\text{Na}_2\text{S}_2\text{O}_4$), monoesters and/or diesters of phosphoric acid of the general formula: $\text{O}=\text{P}(\text{OH})_n(\text{OR})_{3-n}$, n is 1, 2 or 3, Na_2HPO_4 , NaSO_3R ($\text{R}=\text{C}_1-\text{C}_6$ -alkyl or phenyl), Na_2HPO_4 , K_2HPO_4 , TBAF, TEAH, TBAH, TMAH, TMAF, TPAF, TEAB, TBAI, tetrabutylammonium tetrafluoroborate (TBA-TFB), NH_2NH_2 , NH_2OH , $\text{N}(\text{CH}_2\text{CH}_3)_3$ and combinations thereof.

[c22] The composition of claim 20 wherein said salt is further selected from the group consisting of aliphatic hydrocarbons, naphthenic hydrocarbons, aromatic hydrocarbons and combinations thereof.

[c23] The composition of claim 21 wherein said solvent is selected from the group consisting of water, methanol, ethanol, propanol, isopropanol, tert-butyl alcohol, dimethyl sulfoxide (DMSO), acetonitrile, dimethylformamide (DMF), nitromethane, hexamethyl phosphoramide (HMPA), acetone, cyclohexanone, pyridine and combinations thereof.

[c24] The composition of claim 22 wherein said surfactant is

selected from the group consisting of fluorosurfactant (1, 4-dioxane), nonionic surfactant (alcohol ethoxylate), poly (ethylene glycol monooleate), an organic surfactant and combinations thereof.

[c25] The composition of claim 20 wherein said salt is present in an amount ranging from about 1.0 wt% to about 50.0 wt% of said cleaning solution for generating nucleophiles via dissociation in said solvent, and said surfactant is present in an amount ranging from about 0.1 wt% to about 5.0 wt% of said cleaning solution for accelerating surface wetting and preventing corrosion.

[c26] The composition of claim 20 further including an organic acid present in an amount ranging from about 0.1 wt% to about 3.0 wt% of said cleaning solution for increasing the chemical activity of said solution.

[c27] The composition of claim 26 further including a filler present in an amount ranging from about 5.0 wt% to about 20.0 wt% of said cleaning solution to obtain a desired viscosity of said solution.